CHAPTER

11

INSTALLING AND MANAGING PRINTERS

After reading this chapter and completing the exercises you will be able to:

- Explain and apply the fundamentals of Windows 2000 Server printing
- Install local, network, and Internet printing services in Windows 2000 Server
- Configure printing services for all types of needs
- Manage printers and print services
- Solve common printing problems

Network printing is one of the most used resources on any network, because the word-processing, database, computer graphics, and other work performed by users often ends with a printed document as the final product. Printed materials are used for important meetings, presentations, information analysis, and a huge realm of other activities. Because printing is so important, it is also a major source of frustration to users when it does not work well. Fortunately, Windows 2000 Server networks have simplified printing and made it more reliable. Windows 2000 print services are much easier to set up and manage than those in many other server network operating systems that require you to know how to use an army of tools. In Windows 2000 Server, most of the setup and management work is performed from one place, the Printers folder.

In this chapter you learn the basics of how Windows 2000 Server printing works on a local computer, a network, or the Internet. You learn how to set up local, network, and Internet printing services for all kinds of uses, and how to manage them. You also learn to solve problems when printing does not go as planned, for instance when one printer fails and you want to transfer its workload to another printer.

An Overview of Windows 2000 Printing

The network printing process on Windows 2000 Server LANs begins when a client workstation user decides to print a file. For example, in a law firm, a Microsoft Word user prints a file, which goes to the printer designated in the user's Printer Setup configuration within Word. The Printer Setup may direct the printout to the user's local printer or to a network printer available through a printer share for which the user has permission. A shared printer can be a workstation sharing a printer, a printer attached to the file server, or a printer attached to a print server device. The workstation that initially generates the print job is the network **print client**, and the computer offering the printer share is the network **print server**.

A shared printer is an object, like a folder, that is made available to network users for print services. Microsoft also includes faxes as **print device** objects that can be treated in the same way as printers. The print device is offered from a server, workstation, or print server device. Several manufacturers make print server devices that connect directly to the network without the need of an attached computer. These devices eliminate dependence on a computer, which may be shut off or inconveniently located. Some print server devices are small boxes that connect to the network at one end of the box and to one or more printers at the other. Another kind of print server is a card that is mounted inside the printer, with a network port similar to a NIC on the card. One of the most commonly used print server cards is Hewlett-Packard's JetDirect card, used in many laser printers for network printing. Figure 11-1 shows examples of print server devices.

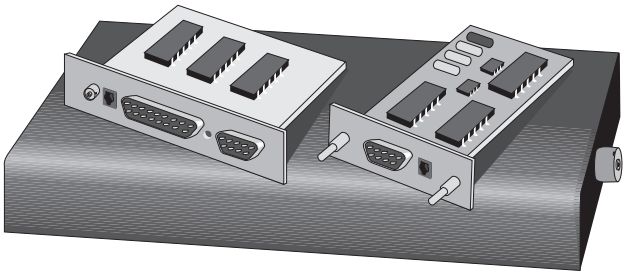

Figure 11-1 Print server devices

When the printout goes to a printer share, it is temporarily spooled in specially designated disk storage and held until it is sent to be printed. **Spooling** frees the server CPU to handle other processing requests in addition to print requests.

Print jobs are usually printed in the same order as received, unless an administrator or printer operator (with appropriate permissions) changes the order because of a high-priority situation. The server administrator can disable spooling, but this is rare because it defeats the value of background print services, which free server and client resources for other tasks.

When its turn comes, the print file is sent to the printer along with formatting instructions. The formatting instructions are provided by a **printer driver** that holds configuration information for the given printer. The formatting and configuration information includes

instructions to reset the printer before starting, information about printing fonts, and special printer control codes.

The printer driver resides on the computer offering the printer services (for local and network print jobs) and also can reside on the workstation client sending the print job. For example, when you send a print job to be printed on a Windows 2000 server print share, your printout is formatted using the printer driver at your workstation and then further interpreted by print services software on the print server. The printer driver is either contained on the Windows 2000 Server CD-ROM or obtained from the printer manufacturer.

When the user selects the option to use a printer share, the document to be printed is formatted for the driver on that share. The printer can start printing the file as soon as the first page is received, or it can be instructed to print the file only when all pages have been received. The advantage of printing immediately, rather than waiting for the entire print file to be spooled, is that printing starts sooner. The disadvantage is that in offices where there are constant print requests, a pause at a workstation sending a print job may result in another job printing pages in the middle of the first job. If this is a problem, it is better to have the printer share wait until the entire file is spooled. This instruction is set at the shared printer. Figure 11-2 shows a summary of printing stages.

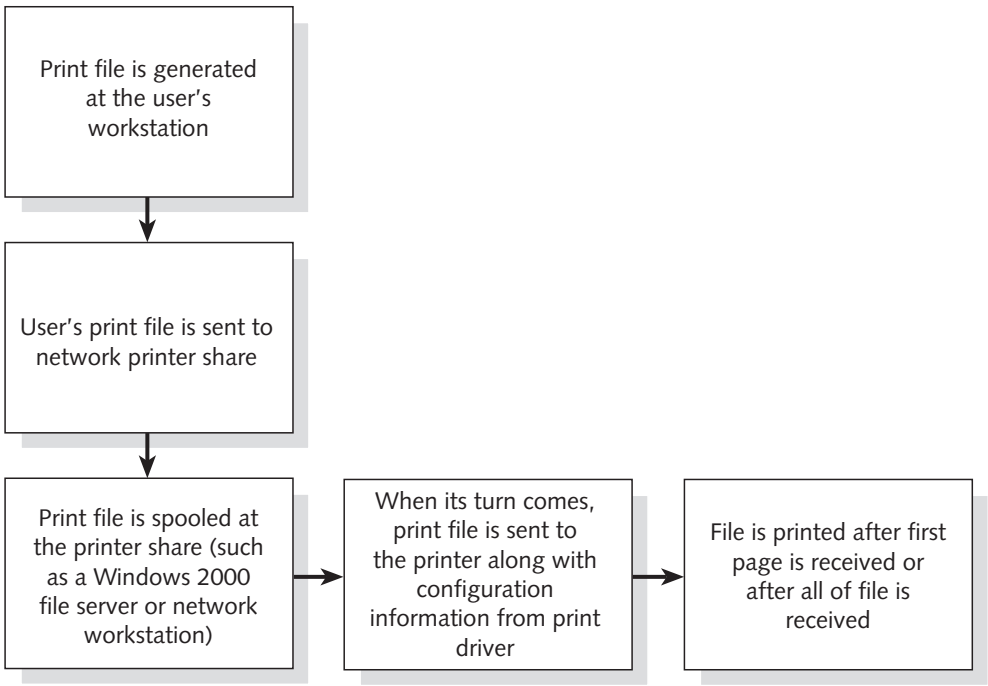

Figure 11-2 Printing stages

How Network Printing Works

In technical terms, both the network print client and the network print server run specific processes to finally deliver a print job to a printer. The first stage in the process is when the software application at the client generates a print file. As it creates the print file, the application communicates with the Windows **graphics device interface (GDI)**. The GDI integrates information about the print file—such as word-processing codes for fonts, colors, and embedded graphics objects—with information obtained from the printer driver installed at the client for the target printer, in a process that Microsoft calls rendering. When the GDI is finished, the print file is formatted with control codes to implement the special graphics, font, and color characteristics of the file. At the same time, the software application places the print file in the client's spooler by writing the file, called the **spool file**, to a subfolder used for spooling. In the Windows 95, 98, NT, and 2000 operating systems, a **spooler** is a group of DLLs, information files, and programs that processes print jobs for printing. Spool files are kept in the \Winnt\system32\spool\printers folder in Windows 2000 Server.

Large print files cannot be processed if there is inadequate disk space on which to store spooled files. Make sure clients and the server have sufficient disk space to handle the largest print requests, particularly for huge graphics and color files that are targeted for a color printer or plotter.

The remote print provider at the client makes a remote procedure call to the network print server to which the print file is targeted, such as a Windows 2000 server. If the print server is responding and ready to accept the print file, the remote printer transmits that file from the client's spooler folder to the Server service on Windows 2000 Server.

The network print server uses four processes to receive and process a print file: router, print provider, print processor, and print monitor. The router, print provider, and print processor all are pieces of the network print server's spooler. Once it is contacted by the remote print provider on the print client, the Server service calls its router, the Print Spooler service. The router directs the print file to the print provider, which stores it in a spool file until it can be sent to the printer. While the file is spooled, the print provider works with the print processor to ensure that the file is formatted to use the right data type, such as TEXT or RAW. When the spool file is fully formatted for transmission to the printer, the print monitor pulls it from the spooler's disk storage and sends it off to the printer.

How Internet Printing Works

When a print job is processed over the Internet or an intranet, the Internet Information Services (IIS) must be installed and running in Windows 2000 Server (see Chapter 13), and the client must connect to the Windows 2000 Server IIS using a Web browser, such as Internet Explorer 4 or higher. The print process on the client is nearly the same as for network printing, with a couple of exceptions. One exception is that it is the browser that sends

the print file to the GDI instead of a software application such as Word. Another exception is that the remote print provider at the client makes a remote procedure call to the IIS on the Windows 2000 Server. The remote procedure call is made through the HTTP protocol (see Chapter 3), which transports another protocol, called the **Internet Printing Protocol** (**IPP**). The IPP encapsulates the remote procedure call and print process information and is transported in HTTP just as a human passenger is transported inside a bus along a highway. The IIS sends the IPP encapsulated information to its HTTP print server, which is composed of the files contained in the folder \Program Files\Common Files\Microsoft SharedWeb Server Extensions\40\Isapi. The HTTP print server works with the regular Windows 2000 spooler services—the print provider, print processor, and print monitor processes—to prepare the print file for transmission to the target printer.

Print Job Data Types

Each print processor is designed to work with a specific data type. A **data type** is the way in which information is formatted and presented in the print file. Some data types involve minimal data formatting for printing, and others involve more extensive formatting. Different data types are used to accommodate printing from different kinds of clients, and they consists of the following:

- RAW
- RAW with FF appended
- RAW with FF auto
- TEXT
- Enhanced metafile (EMF)
- PSCRIPT1

A print file formatted as the RAW data type is often used for files sent from MS-DOS, Windows 3.x, and UNIX clients. It is also the default setting for a PostScript printer (discussed later in this chapter). A RAW print file is intended to be printed by the print server with no additional formatting. In the data type RAW with FF appended, the FF is a form-feed code placed at the end of the print file. Some non-Windows and older 16-bit Windows software do not place a form feed at the end of a print file. The form feed is used to make sure the last page of the file is printed. When RAW with FF appended is designated, the print code for a form feed is written by the Windows 2000 Server print processor as the last thing in the print file. RAW with FF auto means that the print processor checks the print file for a form feed as the last character set, before appending a form feed at the end. If there already is a form feed, it does not add anything to the file.

Prior to the ability to insert a form feed in the print file, many users found it necessary to press the form feed button on a printer or to send another print job to print the last page.

The TEXT data type is used for printing text files formatted according to the ANSI standard that uses values between 0 and 255 to represent characters, numbers, and symbols. You would use the TEXT data type for printing many types of MS-DOS print files, such as text files printed from older word processors or MS-DOS text editors such as EDLIN.

Windows 95, 98, NT, and 2000 clients use the enhanced metafile (EMF) data type. This is the data type that is created when a print file is prepared by the GDI at the client. EMF print files offer a distinct advantage in Windows operating system environments because they are very portable from computer to computer. The RAW, TEXT, and EMF data types are handled by the Windows 2000 *WinPrint* print processor and can be configured when you configure a printer (try Hands-on Project 11-1).

The PSCRIPT1 data type is intended for Macintosh clients that print on a Windows 2000 print server. The print processor uses this data type to translate a PostScript coded print file into one that can be printed on a non-PostScript printer. Using the PSCRIPT1 data type, the Windows 2000 print processor builds a bitmap file, which is again reformatted to be printed on the target printer. If you use this data type, keep in mind that bitmap files can be very large, requiring extra disk space for the spooler. The PSCRIPT1 data type is offered through the *SFMPSPRT* print processor when you configure a printer.

Windows 2000 Print Monitors

Microsoft provides a range of print monitors with Windows 2000 Server. The print monitors, located in the folder \Winnt\system32, are used to do local printing and to print using specialized print servers such as those from Hewlett-Packard, Macintosh, and others. **Local printing** refers to printing on the same computer to which print devices are attached. When you install a local or network printer in Windows 2000 Server, configure the port to which the printer is connected so that it uses one of the print monitors provided through Windows 2000 Server.

The local print monitor is the file Localmon.dll, which handles print jobs sent to a local physical port on the server, such as an LPT or COM port, and is set up by using the *Local Port* option in the printer configuration. (try Hands-on Project 11-2 to practice configuring the local port option). It also sends print jobs to a file, if you specify *FILE* as the port. When a print job is sent to FILE, there is a prompt to supply a filename.

The combination of Ipmontr.dll and Tcpmon.dll files is used for TCP/IP-based printers that are connected to the network through print server cards or print servers, as shown in Figure 11-1. When you configure a printer to use a *Standard TCP/IP Port*, these are the print monitors that are used.

The line printer (LPR) print monitor consists of two files, Lprmon.dll and Lpr.exe, and is used when you configure a printer for an LPR port. This is employed for transmitting files by means of the Microsoft TCP/IP Printing service for printers connected to a UNIX, DEC VAX, or IBM mainframe computer or from these computers as clients to printers attached to Windows 2000 servers. To use this, you first need to install the TCP/IP protocol in Windows 2000 Server and Print Services for UNIX (part of the Other Network File and Print Services that is a Windows component installed through Add/Remove Programs in

the Control Panel). Also, to use LPR, there must be a line printer daemon (LPD) server. The LPD server can be a UNIX computer, an MVS (IBM mainframe) computer with TCP/IP, a computer running Windows NT or 2000, or a print server device such as a Hewlett-Packard JetDirect card in a Hewlett-Packard printer. If you create an LPR port on the server, you will need to provide the IP address of the LPD server.

LPR is not one of the regular options provided in the port setup, but Lprmon.dll and Lpr.exe are included with Windows 2000 Server. Use the New Port Type option on the Port tab in the printer properties to implement it. LPR combined with an LPD server provides a way to integrate printing on a mainframe, such as an IBM mainframe running open MVS, with network printers. Through it you can use Windows 98 or Windows 2000 Professional, for example, to print a mainframe file to a network printer. Also, when using LPR, you may need to experiment with using either RAW or TEXT as the data type, depending on the software used at the client.

As mentioned in the previous paragraphs, there are several ways to send print jobs to a Hewlett-Packard printer containing a JetDirect print server card, such as using a standard TCP/IP print setup or using LPR when communication with host mainframe computers is involved. Some older HP printers, such as the HP 4Si, and even newer printers may have older JetDirect cards that do not support TCP/IP communications. For these older cards, Hewlett-Packard provides print handling software that employs the option to use the DLC protocol (see Chapter 3). Windows 2000 Server offers a DLC-compatible print monitor, called Hpmon.dll, which even comes with a help file, called Hpmon.hlp, to help you set up a JetDirect card. Both print monitor and help file are located in the folder \Winnt\system32. If you choose to use this monitor, make sure you also install the Microsoft DLC protocol, because Hpmon.dll only works through DLC. Hpmon.dll is set up by using the *Hewlett-Packard Network Port* configuration option.

If you are working on a Microsoft network in which computers cannot send printouts to an HP printer connected to the network through a print server card, determine if the print share is set up to use Hpmon.dll. If it is, each workstation client that needs to use the printer must have DLC installed.

Apple LaserWriter printers and print servers can be used on a Microsoft network by implementing the Macintosh print monitor, Sfmmon.dll. This monitor uses the AppleTalk protocol (see Chapter 3), which means that the Services for Macintosh must be installed on Windows 2000 Server and on clients, such as Windows 2000 Professional or Windows 98. Also, Apple LaserWriters are PostScript printers, requiring that the client and print server software use a LaserWriter driver and that the Windows 2000 Server print server services be set up to use a PostScript separator page (discussed later in this chapter). Use the *AppleTalk Printing Devices Port* configuration to employ Sfmmon.dll for LaserWriter printers.

Macintosh computers can be in groupings of computers called AppleTalk zones. When you set up the AppleTalk Printing Devices Port configuration, the setup automatically detects zones.

Many newer printers use **bidirectional printing**, which means that print communications are transported both ways on the cable at the same time. The bidirectional capability is accomplished using the printer job language (PJL) print monitor, Pjlmon.dll. It makes two-way communications between the printer and the print server possible and enables the print server to automatically obtain information about the printer. Windows 2000 Server uses this monitor when you configure a printer port to enable bidirectional printing.

Printers connected to computers running early versions of NetWare (before version 5) and using IPX/SPX communications (see Chapter 3) can be set up to use Windows 2000 Server as a print server by using two steps in addition to configuring them as network printers in Windows 2000: (1) install NWLink on Windows 2000 Server and on the clients that will access the printers, and (2) install Client Services for NetWare on Windows 2000 Server.

Finally, printers that connect to a USB port on a Windows 2000 Server use the Usbmon.dll print monitor, which is automatically configured when you install and set up the printer driver.

Table 11-1 summarizes the print monitors and their associated files.

Table 11-1 Windows 2000 Server Print Monitors

Print Monitor	File(s)
Local	Localmon.dll
Standard TCP/IP printing	Ipmontr.dll and Tcpmon.dll
Line printer (LPR)	Lprmon.dll and Lpr.exe
Hewlett-Packard older JetDirect cards	Hpmon.dll
Macintosh	Sfmmon.dll
Printer job language (PJL) for bidirectional printers	Pjlmon.dll
USB printer ports	Usbmon.dll

Installing Local and Shared Printers

On a Microsoft network, any server or workstation running Windows 2000 Server, Windows 2000 Professional, or Windows NT, 98, or 95 can host a shared printer for others to use through network connectivity. In Windows 2000 Server, you configure a printer that is attached to the server computer as a local printer and then enable it as a shared printer. When you share a printer, the Windows 2000 server becomes a print server. Figure 11-3 is a simplified representation of how shared printers are connected to a network, including printers connected to servers, workstations, and print server devices.

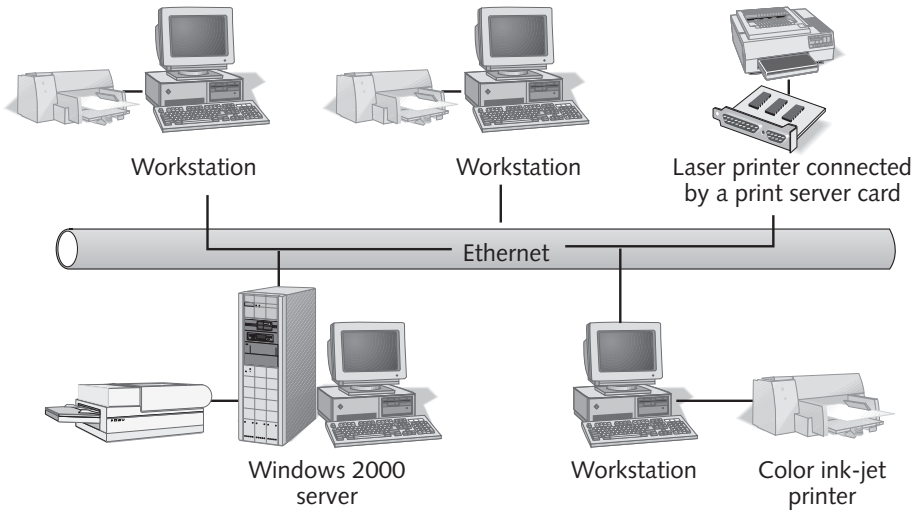

Figure 11-3 Shared network printers

Setting up a printer in Windows 2000 can follow three routes, as described in this section. One is to allow the Add/Remove Hardware Wizard to detect and set up a new printer. A second is to use the Add Printer Wizard, but to yield control to the Add/Remove Hardware Wizard. Both of these routes use Plug and Play detection and do not enable you to customize the printer setup during installation, which means you must do that later through configuring the printer's properties. If you do not use Plug and Play detection, or the printer is not detected through Plug and Play, you have more opportunity to customize the printer setup as you install it.

When you first connect a printer to a Windows 2000 server, it is recommended that you shut down the server, connect and power on the printer, and then reboot the server. Shutting down the server helps to ensure that you do not damage the port used to connect the printer (unless you are using a USB port). When the server reboots and you log on as Administrator (or with Administrator privileges), Windows 2000 Server will automatically install the printer entirely, or it will start the Found New Hardware Wizard (the same as the Add/Remove Hardware Wizard). The level of automatic detection will depend on the printer model, the printer driver, and the printer's implementation of Plug and Play. If Windows 2000 Server starts the Found New Hardware Wizard, click Next to view the screen in Figure 11-4.

Figure 11-4 Add/Remove Hardware Wizard detecting the printer

Decide whether to have Windows 2000 Server search for a driver or display a list of drivers. For example, if you want to install the most current driver from a floppy disk or CD-ROM provided by the manufacturer, click *Display a list of the known drivers for this device so that I can choose a specific driver* and click Next. Click the Have Disk button, insert the floppy disk or CD-ROM containing the driver, provide the path to the floppy disk or CD-ROM, and click OK (the manufacturer's setup may ask you to provide additional information about the printer). Click Next, if the Wizard shows a dialog box specifying that it will install the default settings for the printer. Click Finish.

After the Add/Remove Hardware Wizard is finished, open the Printers folder to view the printer you installed and other printers installed previously. The Printers folder also contains the Add Printer Wizard, which provides another way to install a new printer. There are several ways to open the Printers folder. One is to open the Control Panel and click the Printers folder. The Printers folder also is available by clicking the Start button and pointing to Settings. Another way to manage a printer or to start a local printer installation is by clicking Start, clicking Programs, clicking Administrative Tools, clicking Configure Your Server, and clicking Print Server. Once the Printers folder is open, you can modify a printer's configuration by right-clicking that printer and clicking Properties.

When you use the Add/Remove Hardware Wizard to detect and install a printer, the Wizard enables printer sharing by default. Immediately check and modify the security settings in the printer's properties to make sure they are appropriate.

If you connect a printer without shutting down the server, or if the Add/Remove Hardware Wizard does not automatically detect the printer, open the Printers folder and double-click the Add Printer icon to start the Add Printer Wizard, and then click Next. The Add Printer Wizard starts, as shown in Figure 11-5. There are two radio buttons on the dialog box, one for setting up a printer connected to the server and one for setting up a printer already shared on the network. The Local printer option configures a printer directly connected to the Windows 2000 server. [The Network printer option sets up a shared printer from another computer on the network that the Windows 2000 Server can both print and manage (discussed later in this chapter)]. Click the Local printer radio button and check the option to *Automatically detect and install my Plug and Play printer*, then click Next. If the printer is detected by the Plug and Play service, the Add Printer Wizard will automatically start the Add/Remove Hardware Wizard to install the printer. When the Add/Remove Hardware Wizard finishes, it returns control to the Add Printer Wizard, which provides an option to print a test page. Click Yes to print the test page, and click Finish.

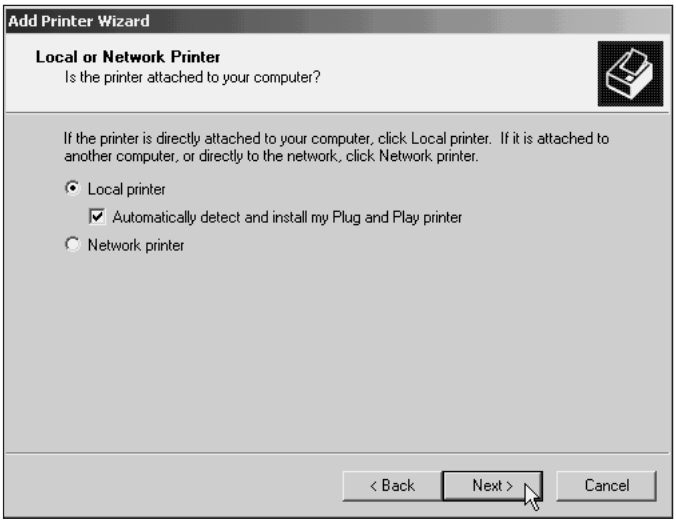

Figure 11-5 Setting up a local printer

If Windows 2000 Server is not able to detect a printer through Plug and Play, use the Administrative Tools Computer Management tool to make sure that the Plug and Play service is started and that the service is not disabled (see Chapter 6).

If the printer is not automatically detected, you can set it up manually by clicking Next in the dialog box that reports that Windows could not detect the printer. The next screen is used to select the printer port to which the printer is attached. There are options to use parallel ports LPT1, LPT2, or LPT3, and serial ports COM1 through COM4. Also, there is an option to direct print jobs to a file, rather than to print them. This option might be useful for capturing print output to send later to a fax or to store in a file for use by a graphics program. The *Create*

a new port radio button is used to add a particular print monitor from the choices already described: AppleTalk Printing Devices, Hewlett-Packard Network Port, Local Port, and Standard TCP/IP Port.

If you do not specify a print monitor, the Wizard installs both Local Port (Localmon.dll) and Standard TCP/IP Port (Ipmontr.dll and Tcpmon.dll). Click Next after you configure the port information.

The Add Printer Wizard requests information about the printer manufacturer and the printer model, as shown in Figure 11-6. In the Manufacturers and Printers selection boxes, scroll to the manufacturer and printer model. With both selected, click Next or insert the printer driver disk supplied by the manufacturer into drive A (or use the Windows 2000 Server CD-ROM), and click Have Disk.

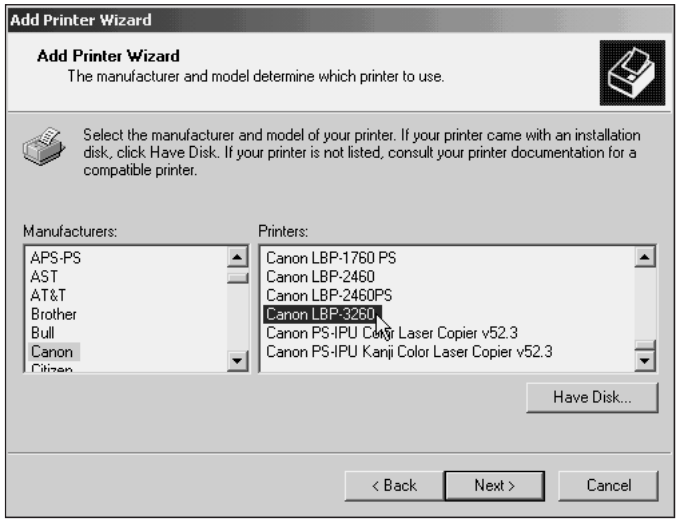

Figure 11-6 Entering the type of printer

If you click Have Disk, enter the path, such as D:\, to the driver disk in the *Copy manufacturer's files from* box in the Install From Disk dialog box. Click OK and wait briefly for the Wizard to load the driver to the server.

After the driver is loaded, you need to enter a name for the printer and to decide whether or not to set it up as a shared printer. You also need to provide a name for the printer share. The printer name will appear as an icon in the Printers folder, while the share name is what users will see when they access the printer from the network. Many server administrators use the same name for both, simplifying management of the printer by eliminating confusion from having two names for one printer. As a rule, a printer and a printer share name are easiest to manage and use if some basic guidelines are followed, such as:

- Compose names that are easily understood and spelled by those who will use the printer.
- Include a room number, floor, or workstation name to help identify where the printer is located.
- Include descriptive information about the printer, such as the type, manufacturer, or model.

For example, if the server name is Lawyer and the printer is a Hewlett-Packard DeskJet color printer, the name and share name might be Lawyer_Deskjetc. Or if the printer is located in the Administration Building and is a laser printer, you might call it Admin_Laser. Develop a printer-naming scheme for your organization from the beginning of the server installation. It is hard on users if you change names after a printer has been in use, because your users will have to reinstall those network printers at their workstations.

On networks in which there are MS-DOS workstations, it may be necessary to limit printer share names to eight characters or fewer, since this is the maximum MS-DOS can decipher.

Enter the printer name in the Printer Name box, select whether you want this printer to be used as the default for print jobs that originate at the server, and then click Next. On the screen that follows, click the Shared radio button if you want to share the printer on the network. If the printer is to be shared, enter the printer share name in the *Share as* box (see Figure 11-7). Click Next and click Yes to confirm the name, if it is over eight characters and there are no MS-DOS clients. If there are MS-DOS clients, click Back and enter a name that is eight characters or fewer.

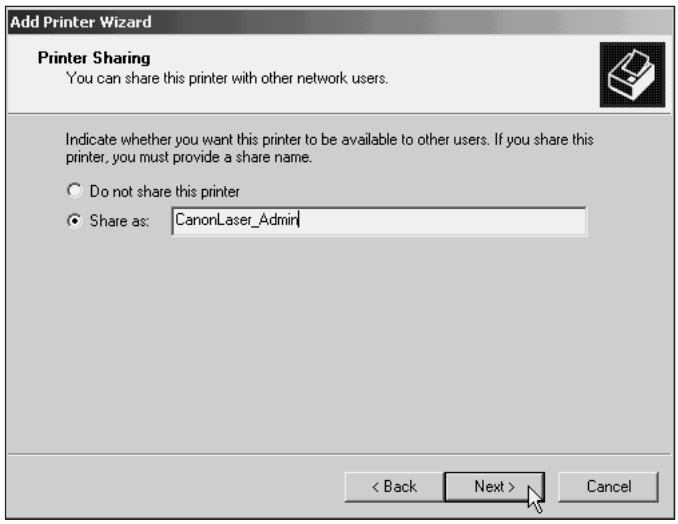

Figure 11-7 Creating a shared printer

If you choose to make this a shared printer, enter the location of the printer and a comment to describe the printer—both of which are used to provide users with information about the printer—and click Next. Click Yes (recommended) to print a test page, as a way to check that the setup is working, and then click Next. Review the setup information and click Finish (see Figure 11-8), or click Back to change a parameter. If you selected to print a test page verify it and click OK in the next dialog box, or if there is a problem, click the Troubleshoot button, which displays remedies via the Print Troubleshooter. To use the Print Troubleshooter, click the description of the problem and then click Next. Also, you can confirm that a shared printer is available on the network by checking for it in My Network Places. (Try Hands-on Project 11-3 to install a local printer, share it, and practice using the Print Troubleshooter.)

Figure 11-8 Printer setup summary

Configuring Local and Shared Printers After Installation

The setup information that you specify while stepping through the Add/Remove Hardware Wizard or the Add Printer Wizard can be modified and further tuned by accessing the Properties dialog box for a printer. Printer properties are available by opening the Printers folder, right-clicking the printer you want to modify, and clicking Properties. You can manage the following functions associated with a printer from the tabs in the Properties dialog box:

- General printer information
- Printer sharing
- Printer port setup
- Printer scheduling and advanced options
- Security
- Device settings

These are the main printer properties available after a printer is installed. Other properties and tabs may be available, depending on the printer and its driver, such as a Color Management and Services tab for printers that support color printing.

General Printer Specifications

The title bar and top portion of the General tab show the name of the printer (see Figure 11-9). The Location and Comment boxes are used to store special notes about the printer that can help distinguish it from other printers, particularly for the sake of users if the printer is shared on the network. Below the Comment box is the printer model name, and under that is an area that describes features of the printer, such as its speed and resolution. The Printing Preferences button is used to specify additional information about printing, such as whether to use portrait or landscape printing as the default and the default paper source, if the printer supports special trays and sheet or envelope feeders. Also, the Print Test Page button enables you to print a test page as a way to verify that the printer is working.

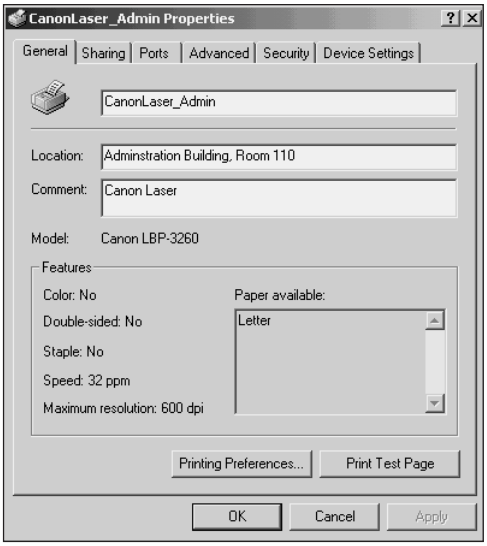

Figure 11-9 Printer Properties General tab

Sharing Printers

The Sharing tab is used to enable or disable a printer for sharing, as well as to specify the name of the share (see Figure 11-10). You can use this if you decide to set up a printer for sharing after you have configured it in the Add Printer Wizard or to turn off sharing if the printer is configured using the Add/Remove Hardware Wizard. Click *Not shared* to turn off sharing, or click *Shared as* to turn it on. If you enable sharing, provide a name for the shared

printer and check *List in the Directory* to publish the printer through the Active Directory. When you publish a printer, Windows 2000 Professional clients and other client operating systems that have the Directory Service Client software installed (see Chapter 8) can easily find it and other network printers by clicking Start, Search, or Find (depending on the operating system), and For Printers or Printers (depending on the operating system).

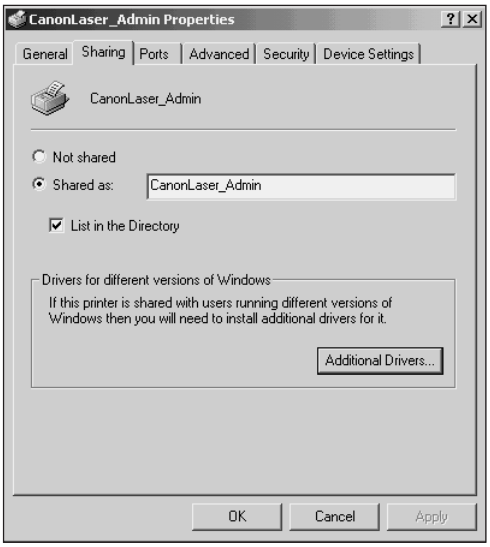

Figure 11-10 Configuring printer sharing

Another way to publish a printer in the Active Directory is to open the Active Directory Users and Computers tool, right-click the domain, click New, click Printer, and enter the UNC path to the shared printer.

The group policy to allow printers to be published should be enabled by default. However, make sure it is enabled by opening the Group Policy MMC or by editing the group policy using the Active Directory Users and Computers tool. To edit the policy, open the Group Policy MMC, for example for the Default Domain Policy when the Active Directory is installed. Double-click Computer Configuration, double-click Administrative Templates, and double-click Printers. Double-click *Allow printers to be published,* click Enabled, and click OK. Also, if you want to make sure the Windows 2000 server can use printers over the Internet or through an intranet, double-click *Web-based printing* and make sure it is enabled.

The Additional Drivers button on a printer's properties Sharing tab (refer to Figure 11-10) is used to add new types of clients, if there are clients who will access the shared printer from computers running non-Windows 2000 operating systems. For example, if there are Windows 98 clients and Windows NT 4.0 clients, click the Additional Drivers button and check the boxes for these operating systems. When you check these boxes, the client does not need to already have a printer driver for the shared printer, because it can instead use

the driver already provided by the Windows 2000 print server for the client's operating system. A client can load the driver by finding the shared printer in the Active Directory listing, My Computer, or My Network Places and selecting the option to install or connect (depending on the operating system).

There are two philosophies about loading the printer driver from the server to the client. On the positive side, loading the driver in this way saves users work because they do not have to find their operating system installation disks to load a printer driver. Also, this practice helps ensure that all clients are using the same driver version, which reduces your individual client support work. On the negative side, if the server administrator does not regularly update printer drivers at the server, then after several months these drivers may be out of date. In the latter case, it is better to leave additional operating systems unchecked to force new users to load more recent drivers from their own operating system disks or from the manufacturer.

Port Specifications

The Ports tab has options to specify which server port, such as LPT1, is used for the printer, and options to set up bidirectional printing and printer pooling (see Figure 11-11). Bidirectional printing is used with printers that have bidirectional capability. A bidirectional printer can engage in two-way communications with the print server and with software applications. These allow the printer driver to determine how much memory is installed in the printer, or if it is equipped with PostScript print capability. The printer also may be equipped with the ability to communicate that it is out of paper in a particular drawer or that it has a paper jam.

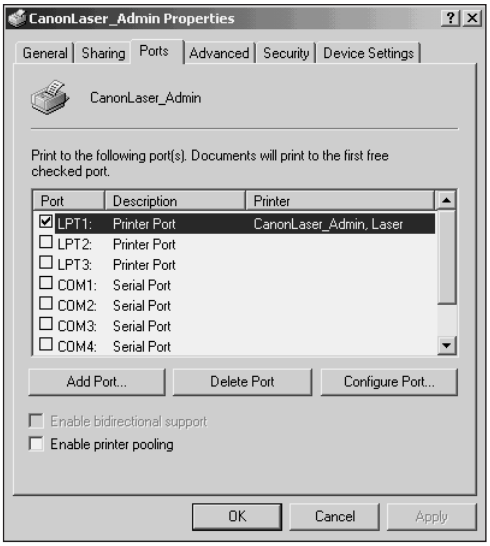

Figure 11-11 Configuring printer ports

Before you connect a printer, consult the manual to determine whether the printer is bidirectional. If so, the printer requires a special bidirectional cable labeled as an IEEE 1284 cable, and the printer port may need to be designated as bidirectional in the computer's BIOS setup program. Check both of these contingencies if you have a bidirectional printer, but the bidirectional box is deactivated on the Ports tab.

Printer pooling involves configuring two or more identical printers with one print server setup. For example, you might connect three identical laser printers (except for port access) to one parallel port and two serial ports on a Windows 2000 server. On the Ports tab, check the *Enable printer pooling* box, and then check all of the ports to which printers are attached, such as LPT1, COM2, and COM3.

All of the printers in a pool must be identical so that they use the same printer driver and handle print files in the same way. The advantage of having a printer pool is that the Windows 2000 print monitor can send print files to any of the three printers (or however many you set up). If two of the printers are busy, it can send an incoming file to the third printer. Printer pooling can significantly increase the print volume in a busy office, without the need to configure network printing for different kinds of printers. Hands-on Project 11-4 gives you practice installing pooled printers.

It is wise to locate pooled printers in close physical proximity, because users are not able to tell to which pooled printer a print job may be sent.

The Add Port button enables you to add a new port, such as a new print monitor or a fax port. Click this button if you need to configure any of the print monitors for specialized printing needs, already described in the section "Windows 2000 Print Monitors." The options are: AppleTalk Printing Devices, Hewlett-Packard Network Port, Local Port, and Standard TCP/IP Port. The Delete Port button is used to remove a port option from the list of ports. The Configure Port button is used to tune the configuration parameters that are appropriate to the type of port. On an LPT port, click the Configure Port button to check the port timeout setting. This setting is the amount of time the server will continue to try sending a print file to a printer, while the printer is not responding. The default setting is normally 90 seconds. Consider increasing the setting to 120 seconds or more if you are installing a printer to handle large print files, such as files for combined graphics and color printing. On a COM port, the Configure Port button is used to set the serial port speed in bits per second, the data bits, parity, stop bits, and flow control.

Printer Scheduling and Advanced Options

The Advanced tab allows you to have the printer available at all times or to limit the time to a range of hours (see Figure 11-12). To have the printer available at all times, click *Always available*; to limit printer use to only certain times, click *Available from* and enter the range of times when the printer can be used, such as from 8:00 AM to 10:00 PM.

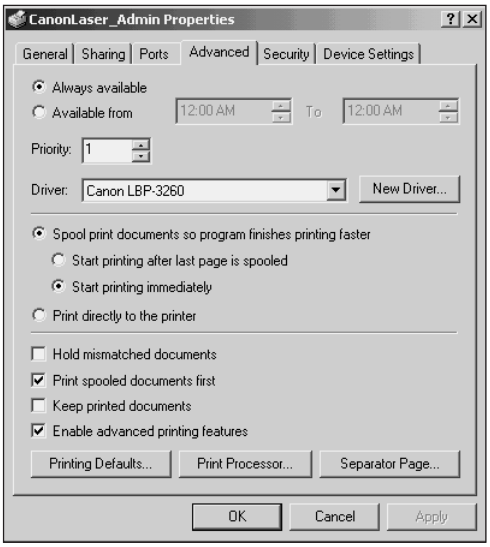

Figure 11-12 Advanced printer properties

You can set the priority higher to give a particular printer or printer pool priority over other printers attached to the server, which applies only if there are two or more printer icons set up in the Printers folder. The priority can be set from 1 to 99. For example, if the server is managing several printer shares, one may be set for higher priority because it prints payroll checks or is used by the company president.

Printer scheduling can be useful when there is one printer and two printer objects (shares) for that printer. One object can be set up for immediate printing, and the other can be used for long print jobs that are not immediately needed. The object for the longer jobs that can wait might be set up so those print jobs are scheduled to print between 6:00 PM and midnight. Another way to handle the longer jobs is to pause that printer object and resume printing when the printer has a light load, such as at noon or during slow times of the day (for information about pausing a printer, see the section "Controlling the Status of Printing").

The Advanced tab provides the option to use spooled printing or to bypass the spooler and send print files directly to the printer. It works best to spool print jobs so they are printed on a first-come, first-served basis and to enable background printing so the CPU can work

on other tasks. Printing directly to the printer is not recommended, unless there is an emergency need to focus all resources on a specific printout. Print spooling also helps ensure that jobs are printed together, so a long Word document is not interrupted by a one-page print job. Without spooling, such an interruption can happen if the one-page job is ready to print at the time the Word job is pausing to read the disk. The spool option is selected by default, with the instruction to start printing before all the pages are spooled. This is an appropriate option in a small office in which most print files are not resource-intensive and there is infrequent contention for printers, reducing the odds of intermixing printouts.

If there is a problem with pages intermixing from printouts, in a busy office, for example, click the option to *Start printing after last page is spooled*.

The *Hold mismatched documents* option causes the system to compare the setup of the printer to the setup in the document. For example, if the printer is set up in a print share as a Hewlett-Packard 5Si and the document is formatted for a plotter, the print job is placed on hold. The job does not print until the document is released by the user, a member of the Print Operators or Server Operators group, or an administrator.

The Hold mismatched documents option is a good way to save paper in a heterogeneous situation, such as a student lab, where users have very different formatted print jobs. One mismatch situation can use hundreds of pages printing one character per page.

The option to *Print spooled documents first* enables jobs that have completed spooling to be printed, no matter what their priority. Where there is high-volume printing, this speeds the process by reducing the wait for long print jobs to spool. The *Keep printed documents* option retains documents in the spooler after they have printed, which enables the network administrator to re-create a printout damaged by a printer jam or other problem. For example, if a large number of paychecks are printing and a printer problem strikes in the middle of the printout, this critical option makes it possible to reprint the damaged checks. However, this option should be accompanied by a maintenance schedule to delete documents no longer needed. *Enable advanced printing features* is an option that permits you to make use of special features associated with a particular printer, such as the ability to print booklets or to vary the order in which pages are printed—back to front, for example.

The Printing Defaults button enables you to specify default settings for print jobs, unless they are overridden by control codes in the print file. These can include the print layout, page print order (front to back), and paper source, depending on the printer.

Use the Print Processor button to specify one of the print processors and data types discussed earlier in this chapter, for example using the WinPrint print processor and the EMF data type for Windows-based clients, or the SFMPSPRT print processor and the PSCRIPT1 data type for PostScript printing.

The Separator Page button is used to place a blank page at the beginning of each printed document. This helps designate the end of one printout and the beginning of another, so that printouts do not get mixed together, or so that someone does not take the wrong printout in a medium or large office setting in which many people share the same printer. Another advantage to using a separator page is that it sends control codes to the printer to make sure that special formatting set for the last printout is reset prior to the next one. In small offices, a separator page may not be needed, because print formatting may not vary, and users can quickly identify their own printouts. Windows 2000 Server has four separator page files from which to choose, located in the \Winnt\System32 folder:

- *Sysprint.sep:* Used with PostScript-only printers and prints a separator page at the beginning of each document
- *Sysprtj.sep:* Used in the same way as Sysprint.sep, but for documents printed in the Japanese language
- *Pcl.sep:* Used to print a Printer Control Language (PCL) separator page on a printer that handles PCL and PostScript
- *Pscript.sep:* Used to print a PostScript separator page on a printer that handles PCL and PostScript

Most non-PostScript laser printers use a version of the **Printer Control Language** (**PCL**), which was developed by Hewlett-Packard.

You can create a customized separator page file by using one of the four default files, adding your own control codes, and saving the file with a different name. Table 11-2 lists the control codes you can use.

Consider the cost of paper before you set up separator pages. If you set up a separator page for each document, and each user also specifies a banner page from the client, the resulting paper costs quickly mount in an office. For example, depending on the setup, there will be one or more extra pages printed per document, turning a one-page original document into two, three, or more printed pages. Many offices sharing a printer simply decide to forgo separator and banner pages, because each person knows what he or she printed anyway.

Table 11-2 Separator Page Customization Codes

Control Code	Result
\	Indicates that the file is a separator page file and must be the first character in the first line of the file
\B\M	Double-width block printing until turned off by \U
\B\S	Single-width block printing until turned off by \U
\D	Includes the date and time of the print job
\E	End of file marker, or can be used to begin a new separator page when there are more than one
\F*path*	Prints a text file located in the *path* designation
\H*nn*	Sends the printer control code *nn* to the printer, but you need to read the printer documentation to find out what control codes can be used
\I	Includes the ID or job number of the print job
\L*mno*	Continuously prints one or more characters as specified, such as *mno*, until the next control code is found in the separator file
\N	Includes the name of the person who sent the print file
\n	Skips *n* lines to enable formatting the separator page
\U	Stops single- or double-wide block printing

Configuring Security

As an object, a shared printer can be set up to use security features such as share permissions, auditing, and ownership. To configure security for a printer, you must have Manage Printer permissions for that printer. Click the Security tab to set up printer share permissions (see Figure 11-13). Usually, the default share permissions are set up so that the Everyone group is granted Print permissions, the Administrators, Print Operators, and Server Operators all have permissions, and the Owner has Manage Documents permissions. Click an existing group to modify its permissions, and use the Add button to add new groups or the Remove button to delete a group from accessing the printer. Table 11-3 lists the printer share permissions that can be set (try Hands-on Project 11-5 to practice setting printer permissions and auditing).

Table 11-3 Printer Share Permissions

Share Permission	Access Capability
Print	Users can connect to the shared printer, send print jobs, and manage their own print requests (such as to pause, restart, resume, or cancel a print job).
Manage Documents	Users can connect to the shared printer, send print jobs, and manage any print job sent (including jobs sent by other users).
Manage Printers	Users have complete access to a printer share, including the ability to change permissions, turn off sharing, configure printer properties, and delete the share.

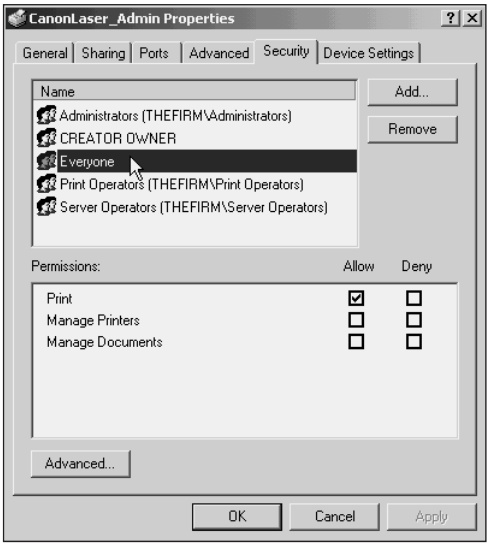

Figure 11-13 Configuring security

By clicking the Advanced button on the Security tab you can:

- Set up special printer permissions for a specific group or user (click the Permissions tab, click the group or user, and click View/Edit)
- Add or remove a group or user for security access or denial (click the Permissions tab)
- Set up printer auditing (click the Auditing tab)
- Take ownership of a printer (click the Owner tab)

Special permissions enable you to fine-tune shared printer permissions, for instance to configure a group that has Manage Printers permission so that group can perform all functions except taking ownership. Any user account or group can be set up for auditing, by clicking the Auditing tab and the Add button. Before you set up printer auditing, make sure that there

is a group policy or default domain policy that enables object auditing on the basis of successful and failed activity attempts. For a shared printer you can track successful or failed attempts to:

- Print jobs
- Manage printers
- Manage documents
- Read printer share permissions
- Change printer share permissions
- Take ownership of the printer

As is true of most objects that can have permissions or share permissions, the available special permissions are the same as the events that can be audited.

If you are not certain what security and group policies are set on a broad scale for a server, an OU, or a domain, use the Security Configuration and Analysis MMC snap-in to analyze the security of a particular group policy, so you can review what is set up and what is not (see Chapter 16). For example, to determine the security set for the default domain policy, load and start the snap-in, create a database for the default domain policy, right-click Security Configuration and Analysis in the tree, and click Analyze Computer Now.

Ownership of a printer created on a Windows 2000 server is usually held by Administrators, because ownership is first given to the account that set up the printer. The Owner tab enables anyone with Manage Printers permissions to take ownership.

Configuring Device Settings

The Device Settings tab enables you to specify printer settings such as printer trays, memory, paper size, and fonts (see Figure 11-14). For example, in many cases, if you have a multiple-tray printer you will leave the paper tray assignment on Auto Select and let the software application at the client specify the printer tray. However, if your organization uses special forms such as paychecks, you can specify use of a designated paper tray when checks are printing.

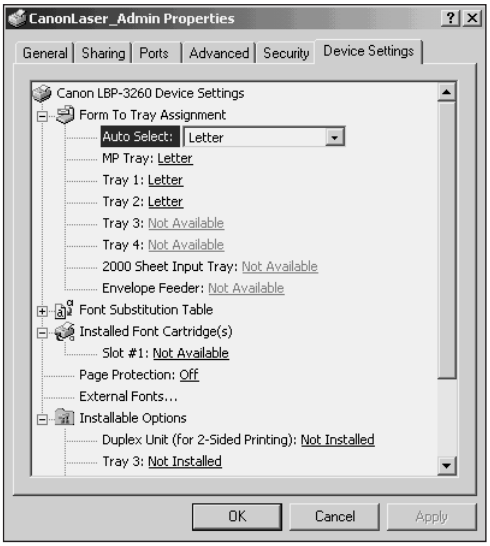

Figure 11-14 Configuring printer device settings

The printer memory is usually automatically detected in bidirectional printers, but if it is not, you can specify the amount of memory in the *Printer Memory* option under Installable Options. In the client operating systems, such as Windows 2000 Professional or Windows 98, the workstation printer setup also can have information about how much memory is installed in a shared printer.

Make sure the memory reported in the device settings matches the memory installed in the printer, because this enables the print server to offload more work to the printer, improving the speed at which print jobs are completed, as well as server performance. Most other settings are better left to the software at the client end to handle. For example, a client printing in Microsoft Word can specify font and paper tray instructions inside the document and by using the Printer Setup.

Allocating Virtual Memory for PostScript Printers

PostScript printers sometimes slow down when printing files containing several fonts and font sizes. A **PostScript printer** is one that has special firmware or cartridges to print using a **page-description language** (**PDL**). PDL printing instructions are performed through PostScript programming code that produces extremely high-quality printing with extensive font options. Windows 2000 Server includes an option to make virtual memory available to a PostScript printer, to circumvent the purchase of extra RAM for that printer. The virtual memory is not part of the paging file that you tune to enhance the server performance. Instead, it is a separate allocation of disk space for PostScript printing.

Virtual memory is a useful way to extend memory capabilities, but keep in mind that disk access speeds (5 milliseconds or less) are slower than RAM access speeds (70 nanoseconds). Virtual memory can help server and printer performance, but it is still no match for the performance boost provided by adding additional RAM to a server for server activities and to a printer for printing fonts, graphics, and colors.

To set up virtual memory for a PostScript printer, first use the Add/Remove Hardware Wizard or the Add Printer Wizard to install the printer. Next, open the Printers folder and right-click the new icon for the PostScript printer. Click Properties and the Device Settings tab. Click Available PostScript Memory and enter the virtual memory size in KB. Consider setting the virtual memory at 1000 KB or more.

A file called Testps.txt is available from Microsoft with recommendations on what memory settings should be used with specific PostScript printers. The virtual memory option is available only for PostScript printers because of their high memory requirements, and is used for storing and managing fonts.

Configuring a Nonlocal Printer or an Internet Printer

There are times when you want to enable a Windows 2000 server to connect to a printer that is not directly connected to one of its ports, for example a printer shared from a workstation, another server, the Internet, or an intranet, or one that is connected to the network through a print server card or device (see Figure 11-1). You can connect to a network printer by using the Add Printer Wizard:

1. Start the Add Printer Wizard, click Next, and then click the Network printer radio button (see Figure 11-5). Make sure the checkmark is removed from *Automatically detect and install my Plug and Play printer* and click Next.
2. The Locate Your Printer dialog box is displayed, with options to: (1) *Find a printer in the Directory* (for Active Directory installations), (2) *Type the printer name, or click Next to browse for a printer*, or (3) *Connect to a printer on the Internet or on your intranet*. Click the appropriate option and click Next. If you specified that you want to find a printer in the Directory, the Find Printers dialog box is started. If you click *Type the printer name, or click Next to browse for a printer* without entering a printer name, a browse box is displayed showing domains and workgroups on Microsoft Networks; it also has the option to browse NetWare-compatible networks (if TCP/IP or NWLink is installed). If you choose *connect to a printer on the Internet or on your intranet*, then you need to provide the URL before clicking Next.
3. Click Yes to print a test page, and then click Next.
4. Click Finish.

When the remote printer is installed on a domain controller, you can change the properties of the shared printer you just installed, even though you are not logged on to its host computer. This means you can manage any remote shared network printer, even though it is not

connected to a port on the server. For example, open the Printers folder and right-click the remote printer you installed. Click the Properties option and make any changes you desire. This capability is very useful when you manage a large network with network printers located in distant buildings. If you need to change the print processor used by a shared printer that is a block away, you can do so without leaving your office.

Configuring a Printer by Identifying Its IP and MAC Addresses

Network printers on TCP/IP networks that have internal print server cards or externally attached print servers can be set up through Windows 2000 Server by identifying them through their IP and MAC (Media Access Control, see Chapter 3) addresses. You do this by configuring the Standard TCP/IP Port option (Ipmontr.dll and Tcpmon.dll) and specifying the address of the print server. For example, to install one of these types of printers using an IP address:

1. Be sure that the printer is turned on and that its print server card or external print server box is connected to the network (and has power, if required).
2. Start the Add Printer Wizard and click Next.
3. Install the printer as a local printer, but uncheck the option to *Automatically detect and install my Plug and Play printer*. Click Next.
4. In the Select the Printer Port window, click Create a new port.
5. Open the Type list box and select Standard TCP/IP Port, as in Figure 11-15 (note that you also can install non-IP print servers using the other options, such as Hewlett-Packard Network Port, Local Port, and AppleTalk Printing Devices). Click Next.
6. Click Next after the Add Standard TCP/IP Printer Port Wizard starts.

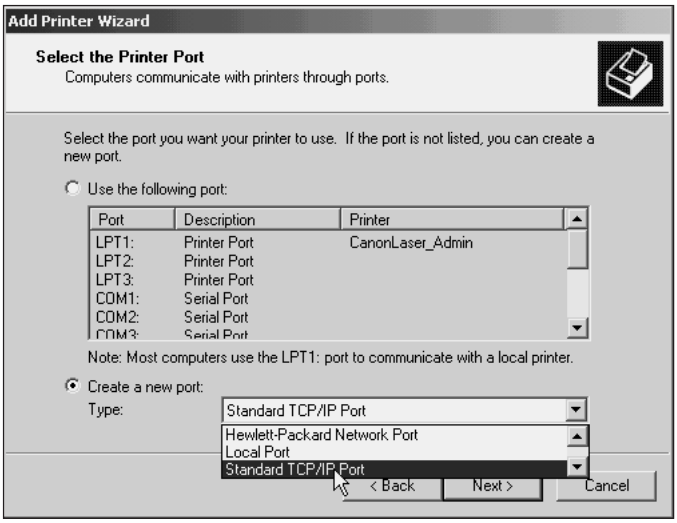

Figure 11-15 Configuring a TCP/IP port

7. Enter the IP address. The Wizard automatically enters a port name on the basis of the IP address, such as IP_129.70.10.7. Click Next. The Add Standard TCP/IP Printer Port Wizard will find the print server to which the printer is attached, by using the IP address and by automatically determining the print server's MAC address from the ARP (Address Resolution Protocol, see Chapter 3). If the printer or print server to which it is attached is not turned on or connected to the network, the Wizard will ask you to troubleshoot the problem before proceeding.
8. Click the Standard radio button under the device type and select the print server model in the list box, or click the Custom radio button and the Settings button to perform a custom setup. Click Next and in the following dialog box click Finish.

If the printer is connected to a mainframe, UNIX, or other host computer and you also must use LPR for enterprise network print services, then select the custom setup. Also, if you want to monitor the print server using the SNMP network monitoring protocol (see Chapters 3 and 15), and you have determined that the print server supports that protocol, use the custom setup to enable SNMP.

9. Back in the Add Printer Wizard, select the printer manufacturer and model, and then click Next.
10. Provide a printer name and choose whether or not to make this the default printer. Click Next.
11. Select the option to share the printer, provide a share name, and click Next.
12. Enter the location of the printer and a descriptive comment about the printer. Click Next.
13. Click Yes to print a test page, and then click Next.
14. Click Finish and click OK if the test page printed, or click Troubleshoot to find help.
15. The printer's Properties dialog box has a new port listed, which has the port name you provided and the description Standard TCP/IP Port (see Figure 11-16). You can change the IP address and other configuration information by clicking the port and then clicking the Configure Port button.

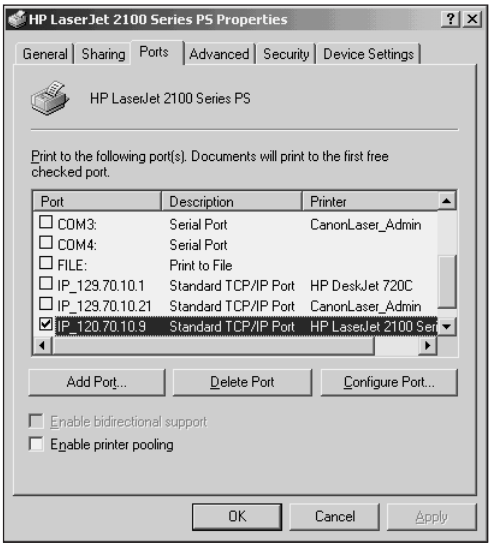

Figure 11-16 The new TCP/IP port

Try Hands-on Project 11-6 to practice setting up a printer through IP addressing.

If you have to replace a print server device and assign a new IP address in its setup, or if you want to turn on SNMP, use the Configure Port button, as described in Step 15.

Managing Print Jobs

In the time after a print job is sent and before it is fully transmitted to the printer, there are several options for managing that job. Users with Print permissions can print and manage their own jobs. Also members of the Printer Operators, Server Operators, and Administrators groups can manage the jobs of others through the Manage Documents and Manage Printers permissions. The printer and print jobs management tool is accessed by opening the Printers folder and clicking the icon for the printer you want to manage. The following options are available to users with Print permissions:

- Send print jobs to the printer
- Pause, resume, and restart their own print jobs
- Delete or cancel their own print jobs

Print Operators, Server Operators, and other groups having only Manage Documents permissions can:

- Send print jobs to the printer
- Pause, resume, and restart any user's print jobs
- Delete or cancel any user's print jobs

Administrators, Print Operators, Server Operators, and any other groups having Manage Printers permissions can do all of the same things as those with Manage Documents permissions, but they also can change the status of the printer, for example to start and stop sharing, set printer properties, take ownership, change permissions, and set the default printer for the Windows 2000 server.

Controlling the Status of Printing

Printer control and setup information for a particular printer is associated with that printer's icon in the Printers folder. For example, if you have two printers installed, HPLaser_Rm20 and InkJet_Rm8, there is a set of properties and printer control information for each printer. If you want to pause a print job on the HPLaser_Rm20 printer, you need to double-click its icon in the Printers folder, and if you want to delete a print job on the InkJet_Rm8 printer, you need to double-click its icon.

If you work frequently at the console of a server, consider setting its default printer to the selection that suits your needs. For example, if you print most to a laser printer called HPLaser_Rm20, then make it the default printer for local printing on the server. You can do that by double-clicking its icon, clicking the Printer menu, and checkmarking Set As Default Printer (see Figure 11-17). After it is set as the default, the printer icon has a check mark next to it (try Hands-on Project 11-3).

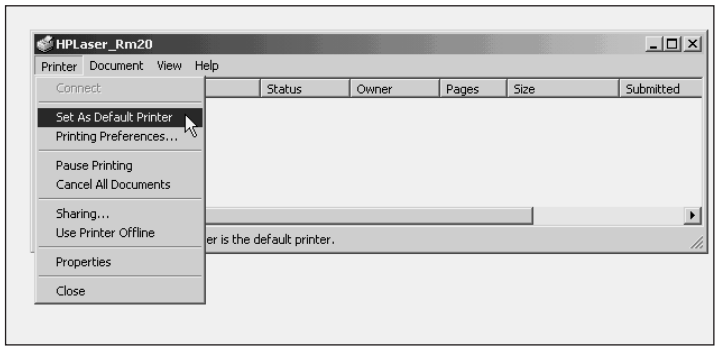

Figure 11-17 Designating a default printer

Sometimes you need to pause a printer to fix a problem, for example to reattach a loose cable or to power the printer off and on to reset it. You can pause printing to that printer by double-clicking its icon in the Printers folder, clicking the Printer menu, and checkmarking Pause Printing. Remember that you need to uncheck Pause Printing before print jobs can continue printing. The Pause Printing capability is particularly important if a user

sends an improperly formatted document to the printer, for example a PostScript-formatted document to a non-PostScript printer. If you do not have Hold mismatched documents enabled, the printer may print tens or hundreds of pages with a single control code on each page. By pausing printing, you have time to identify and delete the document before too much paper is used. (Try Hands-on Project 11-7 to practice pausing a printer.)

Also, you connect or attempt to reconnect a network printer by clicking the Connect option on the Printer menu. If you checkmark the Use Printer Offline option in the Printer menu, then users can view a network printer on their computers even when their computers are disconnected from the network, such as when a laptop is undocked. When the computer is reconnected to the network, the print job is sent to the shared network printer. The Printer menu also has a Properties option to access that printer's properties and a Sharing option, which allows you to turn printer sharing on or off.

Controlling Specific Print Jobs

You can pause, resume, restart, or view the properties of one or more documents in the print queue of a printer. A **print queue** is like a stack of print jobs, with the first job submitted at the top of the stack and the last job submitted at the bottom, and all of the jobs waiting to be sent from the spooler to the printer.

To pause a print job, open the Printers folder and double-click the icon for the target printer. The resulting window shows a list of jobs to be printed, the status of each job, the owner, the number of pages to be printed, the size of the print file, and when the print job was submitted. Click the document you want to pause, click the Document menu, and then click Pause. That print job will stop printing until you highlight the document and click Resume or Restart on the Document menu. Resume starts printing at the point in the document where the printing was paused. Restart prints from the beginning of the document. Keep in mind that portions or all of a document may already have been sent to the printer's memory. You only pause from the portion that is left in the print server's spooler. If the printer has a large amount of memory, such as 1, 2, or more megabytes, you may not be able to pause a document before it is loaded into the printer's memory.

You also can use the Document menu to cancel a print job. First click the job in the status window, click the Document menu, and click Cancel (try Hands-on Project 11-7).

Jobs print in the order they are received, unless the administrator changes their priority. Jobs come in with a priority of 1, but can be assigned a priority as high as 99. For example, if you work for a university, the president may need to quickly print a last-minute report before going to a meeting with the trustees. You can give the president a 99 priority by clicking her print job in the window listing the print jobs. Next click the Document menu, Properties, and the General tab. The Priority box is in the middle of the General

tab. Move the priority bar from Lowest (1) to Highest (99), and click OK. (Learn where to set print priority in Hands-on Project 11-7.)

You also can use the General tab to set a time for selected jobs to print on a printer. For example, if the server is very busy during the day, you can ease the load by setting jobs to print at a certain time of day, such as from noon to 1 PM If you do schedule printing, plan to notify the users of that printer in advance. The General tab also shows the size of a print file, the owner, the data type used, the print processor used, and when the job was submitted.

Moving Print Jobs

Sometimes a printer can malfunction at the worst time, such as when your organization is working to meet a deadline for a project and is printing hundreds of pages for multiple copies of a report. In this or similar situations, you can move the unfinished print jobs to another shared printer that is working. You do this in one of two ways: (1) by moving the jobs to another port already configured, for multiple or pooled printers already connected to a print server, for example, or (2) by adding a new port on the broken printer's setup that points to the working printer, then specifying the path to that printer.

For example, consider a situation in which printer Pub_5Si, which is connected to LPT1, is broken, but Pub_4Si, which is connected to LPT2 on the same Windows 2000 server, is working. To move the print jobs, open the Printers folder, right-click Pub_5Si, click Properties, and click the Ports tab. Click LPT2, which also shows that Pub_4Si is connected to it, and click OK.

In another situation, printer Laser_Rm1, which is directly connected to the Admin server, is broken, but Laser_Rm5, a printer that is connected to the Accounts server in another room, is working (assume that both printers use the printer name for the share name too). To move the print jobs, open the Printers folder, right-click the Laser_Rm1 icon, and click Properties. Click the Ports tab and the Add Port button. Click Local Port in the Printer Ports dialog box, and click the New Port button. Enter the UNC path to the working printer, for instance \\Accounts\Laser_Rm5, and click OK. Click Close in the Printer Ports dialog box, and Apply and Close in the Laser_Rm1 dialog box (try Hands-on Project 11-2 to transfer a print job).

If you cannot redirect printer jobs, the most likely cause is that you do not have Manage Printers permissions on the two printers.

Solving a Common Printing Problem

One common printing problem occurs when the Windows 2000 Print Spooler service experiences a temporary problem, gets out of synchronization, or hangs. Because the spooler contains several complex pieces, it is a source of printer problems. The result is that print jobs are not processed until the problem is solved. If a print job is not going through, and you determine

that the printer(s) are not paused and that the cable connection is good, then stop and restart the Print Spooler service. You do this by clicking Start, pointing to Programs, pointing to Administrative Tools, clicking Computer Management, and clicking Services and Applications in the tree. Double-click Services and scroll to Print Spooler. Check the status column to determine if it is started, and make sure that it is set to start automatically. If it is not started, if it is not set to start automatically, or if you need to stop and restart the spooler, double-click Print Spooler. To start the service, click Start. If you need to set it to start automatically, set this option in the Startup type box; to stop and restart the service, click Stop and then click Start. Make sure that the service status is Started and that the startup type is Automatic. Click OK.

Warn users before you stop and restart the Print Spooler service, because queued print jobs will be deleted.

Because the Print Spooler service is dependent on the Remote Procedure Call (RPC) service, check to make sure that the Remote Procedure Call service is also started and set to start automatically. Further, make sure that the Server service is working, if you have spooler problems.

Chapter Summary

- As with most computer operating systems, you can connect one or more printers to a computer running Windows 2000 Server. Also, a Windows 2000 server can be turned into a print server to enable network users to send documents to printers connected to it and to printers connected to other computers and print servers on a network. Before you configure a Windows 2000 server as a print server, make sure that you understand how network and Internet printing works, including how to use print monitors and data types.
- A new printer can be installed using the Add/Remove Hardware Wizard, the Add Printer Wizard, or a combination of both tools. After a printer is installed, you can modify its properties to match particular printing needs, in literally dozens of ways, from setting defaults for documents that do not use much printer formatting to holding print jobs that have inappropriate formatting for a particular printer. Security can be set on a shared printer to control access, audit printer activity, and set ownership of the printer.
- After a printer is installed and configured, there are options to manage the printer, such as pausing it or canceling all print jobs in its queue. Also, documents can be managed by stopping and restarting them, resetting the printing priority, and canceling one or more documents.

In the next chapter, you learn how to set up and manage remote access to a Windows 2000 server network, and how to configure a virtual private network.

KEY TERMS

bidirectional printing — Ability of a parallel printer to conduct two-way communication between the printer and the computer, for example to provide out-of-paper information; also bidirectional printing supports Plug and Play and enables an operating system to query a printer about its capabilities.

data type — Way in which information is formatted in a print file.

graphics device interface (**GDI**) — An interface on a Windows network print client that works with a local software application, such as Microsoft Word, and a local printer driver to format a file to be sent to a local printer or a network print server.

Internet Printing Protocol (**IPP**) — A protocol that is encapsulated in HTTP and that is used to print files over the Internet.

local printing — Printing on the same computer to which print devices are attached.

page-description language (**PDL**) — Printing instructions involving a programming code that produces extremely high-quality printing with extensive font options.

PostScript printer — A printer that has special firmware or cartridges to print using a page-description language (PDL).

print client — Client computer that generates a print job.

print device — A device, such as a printer or fax, that uses the Spooler services in Windows 2000 Server.

print queue — A stack or line-up of print jobs, with the first job submitted at the top of the stack, the last job submitted at the bottom, and all of the jobs waiting to be sent from the spooler to the printer.

print server — Network computer or server device that connects printers to the network for sharing and that receives and processes print requests from print clients.

Printer Control Language (**PCL**) — A printer language used by non-PostScript Hewlett-Packard and compatible laser printers.

printer driver — A file containing information needed to control a specific printer, implementing customized printer control codes, font, and style information.

printer pooling — Linking two or more identical printers with one printer setup or printer share.

spool file — A print file written to disk until it can be transmitted to a printer.

spooler — In the Windows 95, 98, NT, and 2000 environment, a group of DLLs, information files, and programs that processes print jobs for printing.

spooling — A process working in the background to enable several print files to go to a single printer. Each file is placed in temporary storage until its turn comes to be printed.

Review Questions

1. Someone in your office often sends documents formatted for PostScript to the office's PCL printer, causing it to print page after page of garbage and waste paper. How can you best solve this problem?
   a. Determine who is sending the documents and take away his or her permissions to use the printer.
   b. Configure the printer to hold mismatched documents.
   c. Use printer pooling, but make the second printer a PostScript printer.
   d. Configure the printer to use a different type of separator page for PostScript and PCL print jobs.
2. You have a Hewlett-Packard 4Si printer that contains an older JetDirect card. When you set it up in Windows 2000 Server, you are unable to print to it, even though you have set up the Hpmon.dll print monitor. Which of the following should you check?
   a. that the data type is TEXT
   b. that the port timeout value is decreased to 20
   c. that the server and clients are configured to use the DLC protocol
   d. all of the above
   e. only a and b
   f. only a and c
3. Your boss is on the way to a meeting and needs to print a five-page document in a hurry. Unfortunately, there are 22 documents ahead of his. What can you do to help?
   a. Cancel the documents that are ahead of his, but reschedule them to print later.
   b. Pause and restart the printer to clear the queue, and then resubmit his document.
   c. Stop and restart the print queue, and then resubmit his document.
   d. Give his document a priority of 99.
4. Which of the following is not a shared printer permission?
   a. Full Control
   b. Manage Printers
   c. Manage Documents
   d. Print
5. The power supply in one of your shared printers has burned out. You plan to purchase an identical printer, but not for two weeks. Which of the following enables you to prevent users from trying to use that printer?
   a. Disable the printer sharing.
   b. Change permissions so that no one but you can access the printer.
   c. Set up auditing on the Everyone group, using the failure option.
   d. all of the above

e. only a and b

f. only b and c

6. You are setting up an Intel Netport Express print server that is connected to a network and to a laser printer that is shared on the network. The print server communicates using TCP/IP. How can you set up the print server in Windows 2000 Server by identifying it through its IP address?

   a. Set it up as a Standard TCP/IP Port.

   b. Set it up as a Hewlett-Packard Network Port, because it works like a JetDirect card.

   c. Use the Active Directory Users and Computers tool to set it up through the IP address.

   d. You cannot manage this type of print server through Windows 2000 Server.

7. How do you restart a printer after you have paused it?

   a. Click Restart in the Document menu.

   b. Click Restart in the Printer menu.

   c. Remove the checkmark from Pause Printer in the Printer menu.

   d. Click Connect in the Printer menu.

8. Your office can only afford one printer. The problem is that some people occupy the printer by sending 100-page print jobs that do not need to print immediately. What solution can you use to solve this problem?

   a. Frequently monitor the print queue and pause the long print jobs until near the end of the workday.

   b. Develop a voluntary system so that users with jobs over 50 pages print only during the lunch hour or after 5 P.M.

   c. Change permissions for users who send long print jobs from Print to Limited Print, and then set the limited print jobs to 25 pages or fewer.

   d. Set up two printer objects for one printer, but implement one object for long print jobs and schedule it to print after the workday or overnight.

9. You have purchased a bidirectional laser printer and have verified that the cable connection between the printer and your Windows 2000 server is intact. However, when you configure the printer, the bidirectional box on the Ports tab is deactivated. What should you check?

   a. Open the Device Manager, find the printer, and double-click it to make sure it is connected.

   b. Check to make sure you are using an IEEE 1284 cable.

   c. Check the BIOS setup in the computer to make sure that bidirectional is enabled for the port to which the printer is attached.

   d. all of the above

   e. only a and b

   f. only b and c

10. You are in a meeting to troubleshoot a problem with printing checks for your organization, which has 500 employees. Last night, the printer jammed when checks were printing, and the payroll office spent hours resetting the payroll program to print only certain checks that were damaged. How can you prevent such drastic time loss next time, so the payroll office can go home earlier?
    a. Configure that printer to *Keep printed documents* just before printing the paychecks.
    b. Configure that printer to *Print directly to the printer* just before printing the paychecks.
    c. Schedule paychecks to print at night so there is more time to deal with this problem.
    d. Set the printer to print from Tray 2, because Tray 1 is more likely to cause jams.
11. In the meeting described in Question 10, the payroll manager asks what you would do if paychecks were printing and the printer failed completely. What is your answer?
    a. Use the Windows 2000 Server CD-ROM to reinstall all of the spooler components.
    b. Use the Ports tab for that printer to redirect the check printing to a printer that is working.
    c. Power down the server and reboot it, in case some of its services are not working properly.
    d. Allocate more virtual memory to the printer, in case there is a memory conflict with another process.
12. The _____ integrates information in a print file with a printer driver to prepare a print job for printing.
    a. spooler monitor
    b. data type
    c. graphics device interface (GDI)
    d. Spoolmon.dll file
13. During the last month before closing the books at the fiscal year-end, the Accounting Office prints reams of reports. It is vital that each printed report have the date and time it was printed. How can you accommodate this need?
    a. Activate the Date/Time parameter on the Advanced tab in the properties of the network printers used by the Accounting Office.
    b. Use the scheduling capability of the properties of the network printers so that reports are only scheduled to be printed on certain dates.
    c. Enable use of a separator page and edit the page's parameters to add the /D option.
    d. Use the Date Stamp capability of NTFS to stamp the date on the first page of each report.

14. You power off your company's server, attach a new ink-jet printer, and reboot. After the server reboots, it does not detect the new printer. What is most likely to be the problem?
    a. The printer is bidirectional and cannot be automatically detected.
    b. You must first start the Add/Remove Hardware Wizard to automatically detect new hardware.
    c. You must first PING ink-jet printers to detect them.
    d. The Plug and Play service is disabled.
15. A user is calling you to report that he sent a print job to the printer at least four hours ago and it still has not printed. How can you verify the exact time when the job was submitted, to help in your analysis of the problem?
    a. Check the properties of the print job.
    b. Check the properties of the printer.
    c. Check the printer's Advanced tab.
    d. That information is not available.
16. Several IBM mainframe computers send print jobs to a shared printer connected to your Windows 2000 server. One problem you have noticed is that the last page of the print job is never printed. What would you do?
    a. Use a PostScript separator page.
    b. Edit the Registry and change the printer share to UNIX Enabled.
    c. Use the SFMPSPRT print processor.
    d. Set the data type to RAW [FF appended].
17. You have set up a shared printer on the server, but Sandra Hanson gets an access denied message when she attempts to use the printer. Sandra belongs to two global groups, Managers and Sales, which are members of the domain local groups Managers and Marketing, respectively. Which of the following might be a problem?
    a. You have granted print permissions to the global groups, but not to the domain local groups.
    b. The Managers domain local group is denied Print permissions.
    c. You have granted print permissions to the domain local groups, but not to the global groups.
    d. The Sales global group must also be a member of the Print Operators group.
18. You are setting up auditing via the Security tab on a printer, but you see a message that auditing is not turned on. Your server is a standalone server. What should you do?
    a. Install the Windows Auditing component.
    b. You cannot use auditing on a standalone server.
    c. Turn on auditing in the local group policy.
    d. Turn on auditing for the entire Printers folder.

19. Which document printing option commences a print job from where it left off?
    a. Resume
    b. Reset
    c. Restart
    d. Renew
20. The warehouse for your company has one network printer on its Windows 2000 server, and that printer is always busy printing fulfillment orders. What can you do to help printing go faster?
    a. Increase the port timeout value.
    b. Purchase an identical printer and use pooled printing.
    c. Use a separator page with the /S14400 option to set the printer port speed at 14,000 bps.
    d. Use the compressed printing option.
21. Your Windows 2000 server is a print server for five printers. One of those printers handles the majority of critical print jobs that should print as soon as possible. What should you do?
    a. Attach that printer to LPT1, which is the port with the highest priority on a computer.
    b. Attach that printer to COM1, which is the faster port on a computer.
    c. Assign each printer on the print server a priority from 1 to 5, giving the printer with the critical jobs a priority of 5.
    d. Purchase and set up another server and attach only the critical printer to that server.
22. The Payroll Department has one network printer, called PAY, that is used only to print checks. The printer is always loaded with checks, but kept in a locked room. What other steps would you take to secure this printer?
    a. Set the permissions so that only the Payroll Department can access the printer.
    b. Audit the Everyone group for successful printing to that printer.
    c. Have the Payroll Department take ownership of the printer.
    d. all of the above
    e. only a and b
    f. only a and c
23. You have set up a printer that has two trays. Tray 1 holds letter-sized paper and Tray 2 holds envelopes. Also, you have just added 16 MB of memory so that the printer now has 32 MB. From which tab in the printer's properties do you specify these particular properties?
    a. General
    b. Advanced

c. Device Settings

d. Ports

24. You are setting up a Windows 2000 Server printer to receive print jobs from an IBM mainframe. You set up LPR printing in Windows 2000 Server. What other component must be set up?

a. virtual memory for the printer

b. an LPD server

c. the SNMP protocol

d. Client Service for NetWare

25. You want to configure Windows 2000 to use a printer that is connected through the Internet. How is this possible?

a. Use the Add Printer Wizard and select to install a network printer.

b. Use the Add Printer Wizard and select to install a local printer.

c. Set up the printer first and then configure the Ports tab for Local Port, providing the IP address of the Internet printer.

d. For reasons of security, you can only configure Windows 2000 Professional for Internet printing, and not Windows 2000 Server.

HANDS-ON PROJECTS

Project 11-1

In this project you practice changing the data type to accommodate UNIX and mainframe clients that print to a printer connected to Windows 2000 Server. Assume that you have been experiencing garbled printouts using the TEXT setup and a problem with getting the first page to print. To solve the problem, you change the data type to RAW with FF appended. To practice, you need a printer that is already set up in Windows 2000 Server.

To change the data type:

1. Click **Start**, point to **Settings**, and click **Printers**.
2. Right-click the printer that you want to configure, and click **Properties**.
3. Click the **Advanced** tab and click the **Print Processor** button.
4. What print processors and data types are listed? Record your results in your lab journal or in a word-processed document.
5. Click **WinPrint** and click **RAW [FF appended]**.
6. Click **OK**.
7. What are some other parameters that you can set on the Advanced tab? Record several of these in your lab journal or in a word-processed document.
8. Click **Apply** and then **OK**. Leave the Printers folder open for the projects that follow.

Project 11-2

In this project, assume that you have a small network in which there is a printer connected to the server that has failed and an identical printer shared by a workstation on the network that is working. You practice configuring the print monitor associated with the Local Port option and at the same time learn how to transfer print jobs to the other printer. You will need a printer set up in Windows 2000 Server. Obtain from your instructor the name of a workstation (or server) that has a shared printer.

To configure the print monitor and transfer print jobs:

1. Right-click the same printer that you used in Hands-on Project 11-1, and click **Properties**.
2. Click the **Ports** tab.
3. What port is already set up? Record your observation.
4. Click the **Add Port** button.
5. What port types are available? Record your observations.
6. Click **Local Port** and then click the **New Port** button. Enter the UNC name of the workstation and printer provided by your instructor, such as \\Lab1\HPLaser, and click **OK**. (Note, if your server has two printers connected you can also enter the server name and the name of the other printer.)
7. Click **Close**.
8. Is the new port added to the list of ports? What is the Port name and description?
9. Click **Close**.

Project 11-3

This Hands-on Project gives you experience manually setting up a local printer and sharing it on a network. You also practice using the Microsoft Troubleshooter for printers. Although it is helpful, you do not need to have a printer connected to a Windows 2000 server to complete this project.

To set up a printer:

1. If the Printers folder is closed, click **Start**, point to **Settings**, and click **Printers**. Are there any printers already installed? If so, what are they? Which one is set up as the default printer for this server? Record this information for later use.
2. Double-click **Add Printer** and then click **Next**.
3. Click **Local printer** and remove the check mark from **Automatically detect and install my Plug and Play printer**, if this option is checked. Click **Next**.
4. What port selections are available? Record your observations in your lab journal or in a word-processed document.
5. Click an unused port, such as LPT2 or COM2; or, if there is a printer attached to your computer, select the port to which it is connected. Click **Next**.

6. How many printer manufacturers are represented in the Manufacturers list, and who are they? Select a manufacturer, such as HP, and a printer model, such as HP LaserJet 6L; or if there is a printer connected to your computer, select that printer's manufacturer and model. Click **Next**.

If you select a printer manufacturer and model that is already installed via another printer icon in the Printers folder, a dialog box appears that asks if you want to keep the existing driver or use a new one. If you see this dialog box, click Keep existing driver (recommended), and then click Next.

7. Enter a printer name, such as **HPLaser_Rm2**. Click **Yes**, so that this printer is the default. Click **Next**.
8. Make sure the Share as radio button is selected, and enter the share name, for example **HPLaser_Rm2.** Click **Next**.
9. Enter a location for the printer, such as Room 2, and enter a comment, such as **HP LaserJet 6L printer for all users**. Click **Next**.
10. Click **Yes** to print a test page, regardless of whether there is a printer connected to your computer (so you can access the Print Troubleshooter).
11. Review the information you have entered for the printer configuration, and click **Finish**.
12. When the test information box is displayed, click **Troubleshoot** to view the troubleshooting information.
13. Click **My network server printer won't print**, and click **Next**.
14. Read the troubleshooting information and then click **No, I can't establish a basic network connection**. Click **Next**.
15. Read the troubleshooting information and assume that the problem is that the printer driver is corrupted. Click **To remove and reinstall your default printer**. Since you are just practicing using the Troubleshooter, do not reinstall the printer. Click **Yes I can print from my program** and then click **Next**. How would you go back to find more troubleshooting information?
16. Close the Troubleshooter, but leave the Printers folder open. What printer is now shown as the default? How do you know it is the default printer? If you set up to use a printer that is not connected, click Cancel to the warning that a test page did not print.

To set the default printer back as originally set (refer to step 1 in the first set of steps in this project—if there was an original default):

1. Right-click the printer that was originally set as the default.
2. Click **Set as Default Printer**.
3. Has that printer's icon changed?

Project 11-4

Assume that your office will have heavy printing traffic to the printer you set up in Hands-on Project 11-3. To solve the traffic load, you decide to attach an identical printer to an available communications port and configure the print server for pooling (you do not need another printer to practice setting up pooling).

To configure printer pooling:

1. Right-click the printer that you installed in Hands-on Project 11-3.
2. Click **Properties**.
3. Click the **Ports** tab.
4. Click **Enable printer pooling**.
5. Click **COM3:** or another port that is not in use.
6. Click **Apply**. How has that port's printer assignment changed? Record your observations.
7. How could you print a test page?
8. Click **OK**.

Project 11-5

You need to set up security on the pooled printers installed in Hands-on Projects 11-3 and 11-4. Your boss asks you to remove the Everyone group from access to the printers, but to add Domain Users, which is a domain local group that has specific global groups as members. He also wants you to set up auditing of failed printing attempts for the Domain Users group.

To set up printer security:

1. Right-click the printer that you installed in Hands-on Project 11-3, and click **Properties**.
2. Click the **Security** tab. What security is set up already? Record your observations.
3. Click the **Everyone** group and click **Remove**. Is the Name box updated to reflect the change?
4. Click the **Add** button.
5. Scroll to find **Domain Users** and double-click that selection. Click **OK**.
6. What permissions are given to this group by default?
7. Make sure that the **Allow** box for Print is checked.
8. Click the **Advanced** button.
9. Click the **Auditing** tab.
10. Click **Add**, then find and double-click **Domain Users**.
11. List the contents of the Apply onto box and record the options. Make sure **This printer and documents** is selected.

12. Click the **Failed** box for Print and click **OK**.
13. What information now appears in the Auditing Entries box?
14. Click **OK**. If there is a message that auditing is not turned on as a group policy, how would you turn it on? Also, click **OK** if you see a message that auditing is not turned on.
15. Click **OK**.

Project 11-6

In this activity you set up a JetDirect print server so you can manage it through Windows 2000 Server. If you do not have a printer with a JetDirect card, you can still use this project for practice. Obtain an IP address from your instructor before starting.

To set up the JetDirect print server:

1. Double-click **Add Printer** and click **Next**.
2. Click **Local printer** and remove the check mark from **Automatically detect and install my Plug and Play printer**, if it is checked. Click **Next**.
3. Click **Create a new port** in the Select the Printer Port window, and select **Standard TCP/IP Port** in the Type box. Click **Next**. Click **Next** again when the Add Standard TCP/IP Printer Port Wizard starts.
4. Enter the IP address provided by your instructor, such as 129.88.1.15. What happens to the Port Name box as you enter the IP address? By what other means can you identify the printer, besides by IP address? Record your findings. Click **Next**. If there is no print server connected, the next window will report that it cannot be found on the network. Ignore the message, if you are practicing without an actual print server.
5. Make sure that the **Standard** radio button is selected under the device type, and select **Hewlett Packard Jet Direct** in the list box. Click **Next**. Is the device configured for SNMP? Click **Finish**.
6. When you return to the Add Printer Wizard, select the printer manufacturer, such as HP, and model, such as HP LaserJet 5Si, and then click **Next**.
7. Enter a printer name, such as HPLaser_Rm3, and click **No**. Click **Next**.
8. Make sure that **Share as** is selected and enter the share name **HPLaser_Rm3**. Click **Next**.
9. Enter **Room 3** as the location, and enter **HP LaserJet 5Si printer in Room 3** as the comment. Click **Next**.
10. Click **Yes** to print a test page, if you are working with a live printer; otherwise click **No**. Click **Next**.
11. Click **Finish** and click **OK** if the test page printed, or click **Troubleshoot** to find help.
12. How would you verify that the printer port has been created?

Project 11-7

Assume that the printer you created in Hands-on Project 11-3 is printing sheet after sheet of garbled printing, and you need to pause printing to that printer until you can cancel the print job. This project enables you to simulate pausing the printer and deleting a document.

To pause a printer, cancel a document, and resume printing:

1. Double-click the printer that you installed in Hands-on Project 11-3.
2. Click the **Printer** menu and click **Pause Printing**. Has the title bar of the printer window changed, and if so how?
3. Using a word processor or Notepad, create a document that contains only one or two words, such as Test. Send the document to the printer that you have paused.
4. When the document appears in the printer window, click it.
5. Click the **Document** menu. What options are available to you to control a print job? Click the **Properties** option. How would you reset the priority of this print job from the General tab? Click the **Cancel** button to close the Properties dialog box.
6. Right-click the document that you sent to the printer, and click **Cancel**.
7. Click the **Printer** menu and click **Pause Printing** to remove the check mark.
8. Has the title bar of the printer window changed?
9. Close the printer window.

If your instructor asks you to delete the printer that you created in Hands-on Project 11-3, right-click the printer and click Delete. Confirm the deletion by clicking Yes.

CASE PROJECT

Aspen Consulting Project: Configuring Network Printing

Modular Furnishings manufactures steel and wood furniture products for offices and computer rooms. The manufacturing building has three servers, one that is used for manufacturing, one that tracks inventory, and one that handles product distribution. Because each server is in a central location for its associated function, the company has purchased two identical printers to connect to each server. There also are four printers that attach to the network by means of print server cards. Modular Furnishings has hired you to advise them on the setup of the printers.

1. The manufacturing building has two people who are assigned to manage the printers for the entire building. Modular Furnishings asks you to explain how to set up the printers that are attached to the servers and the printers that have their own print server cards. Develop a general instruction set that they can refer to when setting up a printer. As you develop your instructions, keep in mind that all of the workstations that access the printers are running Windows 98. Also, two of the printers that are

connected to the print server cards are PostScript only. All other printers are PCL only. The network is TCP/IP-based.

2. Explain what permissions should be granted to the two people who will be setting up and managing the printers, and explain how to set up the permissions.
3. The people who are assigned to manage the printers ask for your recommendations on whether to manage all of the printers from one server, from two servers, or from all three. What questions would you ask to help you make recommendations? In general, are all of these options possible? Explain your answers.
4. The inventory process uses a just-in-time (JIT) technique that requires constant printing of tags for each inventory item, and it is anticipated that both of the printers on the inventory server will be continuously busy. How do you recommend setting up the printers for this situation? Create an addendum to your answer in Assignment 1 to explain the specifics of how to implement your recommendation. Also, does your answer to this question affect your response to Assignment 2?
5. The management of the manufacturing unit wants to track all successful and failed printed distribution invoices created from the distribution server. Explain how this can be accomplished.
6. The two printer coordinators have some extra questions about the following:
   - Is there a way to set up large print jobs so that they only print after 7:00 PM, when most employees have gone home?
   - How can a printer be stopped from printing while it is being maintained?
   - Is there a way to retain print files so that they can be reprinted? If so, how are they deleted when no longer needed?

   Prepare a document to answer their questions.
7. Printouts from the printers connected to the manufacturing server often have pages from other printouts mixed in. How can you solve this problem?

Optional Case Projects for Teams

Team Case One

Mark Arnez is curious about the range of Windows 2000 Server printing capabilities. He asks you to form a team to compile as complete a list as possible that explains all of the printing features and options supported in Windows 2000 Server.

Team Case Two

Mark Arnez wants you to form a small group of consultants to develop a troubleshooting flow chart for printing problems that might occur in Windows 2000 Server. Use the Print Troubleshooter and other resources to develop a complete flow chart.